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Process and plant for producing hot-rolled aluminum strip for can making

Description

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The invention relates to a process and a plant for carrying out the process for producing hot-rolled aluminum strip for can making, especially in a rolling plant whose yearly production capacity is below 250,000 tons, having a reversing roughing stage for the feed material, which is used hot, and immediately thereafter finishing rolling of the strip, which is followed by heat treatment of the strip coiled up into coils.

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Discussion of the Prior Art

A Essentially two processes which are used worldwide are known for the hot production of aluminum strip for can making. In accordance with the one process, good qualities are achieved if aluminum block heated to rolling temperature is initially roughed by reversing in a roughing train, for example a four-high reversing roll stand, and is subsequently finish-rolled in a multi-stand rolling train. In the finish-rolling train, four-high roll stands are normally used, care having to be taken that constant temperature conditions are maintained within the train, in order that the strip, which is coiled up into a coil at the end, obtains the desired optimum rolled structure. The aim is a coiling temperature of about 320°C. If the temperature is set appropriately, the finish-rolled aluminum strip obtains the structure which is known in specialist circles and has a cubic texture which,

ear or lobe formation
because of low earing, is particularly well suited to the deep-drawing of aluminum cans.

The other process which is practiced for producing aluminum strip for can making provides for a reversing rolling mill having coilers arranged on both sides for the finishing rolling of the strip. However, the process has the disadvantage that a nonuniform temperature distribution over the length of the strip is established during the winding and unwinding of the strip, and therefore the desired uniform structure development in the unrolled coil cannot be achieved. For this reason, during this process intermediate annealing is carried out during the subsequent cold-rolling process, and although this improves somewhat the capability of the aluminum strip for can making to be deep drawn, it does not develop the cubic texture in the strip material which is beneficial for the deformation operation.

Whereas the last-mentioned process can be used only to a limited extent for the production of strip for can making, for the reasons outlined, the disadvantage of the process described first lies in the high investment costs, especially for the multi-stand finishing rolling train. For this reason, this process can only be used economically in practical terms if the relevant rolling mill can output a yearly production of more than 500,000 tons per year. For smaller rolling mills, so-called minimills, the known process

cannot be used profitably.

SUMMARY OF THE INVENTION

On the basis of the aforementioned disadvantages of the prior art, the object of the present invention is to provide a practicable and economic solution for the production of high-quality strip for can making on hot-rolling mills with a yearly capacity below 250,000 tons, in which the cubic texture which is beneficial for the reshaping of the aluminum strip is developed.

In order to achieve the object, on the basis of a process in which the feed material, which is roughed in a reversing manner, is then immediately finish-rolled, it is proposed to suppress the recrystallization in the rolled material by means of controlled temperature management of the hot strip during the last finishing rolling passes, and specifically to bring about the recrystallization only outside the rolling train, directly following the finishing rolling. It has been shown that an aluminum strip for can making obtains the cubic texture, which is beneficial in the case of multi-stand rolling trains of the generic type, even when no recrystallization takes place in the rolled material during the last finishing passes, that is to say the temperature is kept appropriately low. Instead, the recrystallization takes place only outside the rolling train, following the finishing rolling, and is brought about there by heating the strip coiled up into coils.

Provision is beneficially made for the last, preferably three, hot-rolling passes of the finishing rolling train to be carried out without recrystallization on a reversing roll stand from coil to coil in the noncritical temperature range from 260°C to 280°C, and, immediately thereafter and utilizing the rolling heat, for each coiled finished coil to be fed to a continuous pusher-type furnace for coils, in which the finished coils are heated to recrystallization temperature (315°/320°C).

Taking into account the finding that the hot process for the production of the aluminum strip for can making is, from many points of view, of decisive importance for the performance of the end product, the last three hot-rolling passes are carried out from coil to coil on a finishing rolling mill, specifically for a minimill concept. A finishing rolling mill of this type comprises an individual reversing roll stand with coilers arranged on both sides, so that, in the first place, the high investment costs for the four-high finishing roll stands of a multi-stand rolling train are dispensed with. Since the temperature management and the rolling and pause times - especially in the case of minimill concepts - are critical, the invention provides for the strip to be rolled in the noncritical range from 260°C to 280°C and only then, and utilizing the rolling heat, to heat said strip to recrystallization temperature in a subsequent

furnace. A furnace of this type only has to apply the temperature difference of about 40°-60°C between the rolling temperature and the recrystallization temperature, and thus achieves a favorable energy balance. Annealing before or during the cold-rolling can be dispensed with as a result of the process of the invention. The structure (the cubic texture) corresponds to the product produced on multi-stand hot-strip finishing rolling mills, without the high investment needed there being required.

A plant for carrying out the process according to the invention is defined in that the finishing rolling is carried out on a four-high reversing roll stand with winding devices arranged on both sides, in that one of the winding devices corresponds to a coil transport device for the finished coil and, on the other side, is connected to a continuous pusher-type furnace for coils, into which the coils can be introduced. The plant therefore essentially comprises two reversing roll stands, one of which, as the roughing roll stand, roughs the block, heated to the rolling temperature, in the conventional way, and the second reversing roll stand having coiler devices arranged on both sides is provided, in which the strip is wound and unwound in a number of reversing passes, in each case forming coils. After the last rolling pass, the finished coil is transferred by a coil transfer device to the coil transport device, with

which the finished coil is transported to an adjacent continuous pusher-type coil furnace. After it has been introduced into the continuous pusher-type coil furnace, the coil is heated to recrystallization temperature outside the rolling train, so that the desired structure is obtained.

The continuous pusher-type coil furnace is preferably equipped with a pallet transport system, in which a number of pallets in contact with one another at the ends and holding the coils can be transported through the furnace by displacing these pallets. Such pallet transport systems are known per se; by means of the cyclic displacement of the first pallet by means of a displacement device, for example a hydraulic cylinder, the pallets located in a row one behind another are in each case displaced at the same time, so that as each pallet loaded with a coil is introduced into the furnace, a pallet with a finished, heat-treated coil is ejected on the discharge side of the continuous pusher-type coil furnace. After cooling, the coil is fed to the cold-rolling mill, without any further heat treatment having to be carried out.

An exemplary embodiment of the plant according to the invention is illustrated schematically in the drawing and will be described below.

A BRIEF DESCRIPTION OF THE DRAWING

The single drawing figure depicts a rough, schematic illustration of a plant according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

~~It~~ The plant comprises the four-high reversing roll stand 1, the four-high reversing finishing roll stand 2 following in the rolling direction, and the continuous pressure-type coil furnace 3.

The feed material 4 ~~used at 4~~, in the form of a heated aluminum block, is rolled out, as indicated at 5, in a number of reversing passes in the four-high rolling stand 1 of the roughing rolling train to form a rough strip 6, and is immediately introduced into the finishing rolling train comprising the four-high reversing roll stand 2. In the four-high reversing roll stand 2, the rough strip 6 is rolled out in a number of reversing passes 7 to form a finished strip, the strip being coiled up on either side of the four-high reversing roll stand 2 after each rolling pass, as indicated at 8 and 9. At least three hot-rolling passes in accordance with this procedure are preferably provided. After the last rolling pass, the coil B wound up at 9 is transferred by a transfer device (not illustrated) to a coil transport device ~~indicated at~~ 10 which transports the coil B to the continuous pusher-type coil furnace 3. In front of the end furnace door ~~which is indicated at~~ 3a, the coil B is deposited on a pallet 11, of which a large number of identical pallets 11 can be displaced through the continuous pusher-type coil furnace 3. Using the displacement device 12, in the form of a piston/cylinder unit, the pallet 11 with the

coil B is pushed into the furnace with the furnace door 3a open and, at the same time, a pallet 13 with a completely, heat-treated coil B is ejected at the end of the continuous pusher-type coil furnace 3 through the furnace door 3b, which is likewise open. Inside the furnace in the exemplary embodiment illustrated are a number of pallets 11 which are in contact with one another at the ends and have an identical number of coils B which, during their passage through the continuous pusher-type coil furnace 3, are heated to a temperature above the recrystallization temperature of the aluminum strip, that is to say about 315-320°C. By contrast, the reversing rolling passes 7 in the four-high reversing finishing roll stand 2 were carried out at a temperature below the recrystallization temperature of about 260-280°C.